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## Single-molecule super-resolution light-sheet microscopy.

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### Public Summary:

Single-molecule super-resolution imaging is a new promising tool for investigation of sub-cellular structures. Concurrently, light-sheet microscopy, also known as selective plane illumination microscopy (SPIM), has gained rapid favor with the imaging community in developmental biology due to its fast speed, high contrast, deep penetration, and low phototoxicity. While nearly a dozen reviews thoroughly describe the development of light-sheet microscopy and its technological breakthroughs with a main focus on improving the 3D imaging speed of fish embryos, central nervous system, and other tissues, few have addressed the potential of combining light-sheet microscopy and localization-based super-resolution imaging to achieve sub-diffraction-limited resolution. Adapting light-sheet illumination for single-molecule imaging presents unique challenges for instrumentation and reconstruction algorithms. In this Minireview, we provide an overview of the recent developments that address these challenges. We compare different approaches in super-resolution and light-sheet imaging, address advantages and limitations in each approach, and outline future directions of this emerging field.

### Scientific Abstract:

Single-molecule super-resolution imaging is a new promising tool for investigation of sub-cellular structures. Concurrently, light-sheet microscopy, also known as selective plane illumination microscopy (SPIM), has gained rapid favor with the imaging community in developmental biology due to its fast speed, high contrast, deep penetration, and low phototoxicity. While nearly a dozen reviews thoroughly describe the development of light-sheet microscopy and its technological breakthroughs with a main focus on improving the 3D imaging speed of fish embryos, central nervous system, and other tissues, few have addressed the potential of combining light-sheet microscopy and localization-based super-resolution imaging to achieve sub-diffraction-limited resolution. Adapting light-sheet illumination for single-molecule imaging presents unique challenges for instrumentation and reconstruction algorithms. In this Minireview, we provide an overview of the recent developments that address these challenges. We compare different approaches in super-resolution and light-sheet imaging, address advantages and limitations in each approach, and outline future directions of this emerging field.

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